

Appl. No. 10/807,889
Amdt. Dated January 11, 2006
Reply to Office Action of October 12, 2005

Attorney Docket No. 81864.0037
Customer No. 26021

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) An R-T-B system rare earth permanent magnet, which comprises a sintered body comprising:

an $R_2T_{14}B$ phase (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y) and T represents one or more transition metal elements essentially containing Fe, or Fe and Co) as a main phase; and

a grain boundary phase containing a higher amount of R than said main phase,

wherein, when μ_c (permeance coefficient) is 2,

if a total flux is defined as f_1 under the application of an effective magnetic field of 240 kA/m (providing that an effective magnetic field = an applied magnetic field - a demagnetizing field, and each value of them is absolute value),

if a total flux is defined as f_2 under the application of an effective magnetic field of 800 kA/m, and

if a total flux is defined as f_3 under the application of an effective magnetic field of 2000 kA/m,

a magnetization rate a ($= f_1/f_3 \times 100$) is 40% or more, and

a magnetization rate b ($= f_2/f_3 \times 100$) is 90% or more.

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2. (Original) An R-T-B system rare earth permanent magnet according to claim 1, which has a coercive force (H_{cJ}) is 1,672 kA/m or less.

3. (Original) An R-T-B system rare earth permanent magnet according to claim 1, which has a residual flux density (B_r) of 1.35 T or more, a maximum energy product ($(BH)_{max}$) of 350 kJ/m³ or more, and a squareness (H_k/H_{cJ}) of 95% or more.

4. (Original) An R-T-B system rare earth permanent magnet according to claim 1, wherein a mean grain size is between 3.3 and 4.3 μm in said sintered body.

5. (Original) An R-T-B system rare earth permanent magnet according to claim 1, wherein the amount of oxygen is 1,500 ppm or less in said sintered body.

6. (Original) An R-T-B system rare earth permanent magnet according to claim 1, wherein Zr is dispersed in said sintered body.

7. (Currently amended) An R-T-B system rare earth permanent magnet, which comprises a sintered body with a composition comprising of 25% to 35% by weight of R (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y)), 0.5% to 4.5% by weight of B,

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0.02% to 0.5% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 2% or less (excluding O) by weight of Co, and the balance substantially being Fe,

wherein the amount of oxygen is 2,000 ppm or less in said sintered body, and a mean grain size is between 3.3 and 4.3 μm in said sintered body

wherein the amount of nitrogen is 20 to 600 ppm and the amount of carbon is 1,500 ppm or less in said sintered body.

8. (Original) An R-T-B system rare earth permanent magnet according to claim 7, which comprises 0.1% to 4.0% by weight of Dy as R.

9. (Original) An R-T-B system rare earth permanent magnet according to claim 7, wherein Zr is dispersed in the grain boundary phase of said sintered body.

10. (Original) An R-T-B system rare earth permanent magnet according to claim 7, which is a multipolar magnet.

11. (Canceled).

12. (Original) An R-T-B system rare earth permanent magnet, which comprises a sintered body comprising:

an $\text{R}_2\text{T}_{14}\text{B}$ phase (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y) and T represents one or more

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transition metal elements essentially comprising Fe, or Fe and Co) as a main phase;
and

a grain boundary phase containing a higher amount of R than said main phase,

wherein, when P_c (permeance coefficient) is 2,

if a total flux is defined as F_1 under the application of an effective magnetic field of 240 kA/m (providing that an effective magnetic field = an applied magnetic field - a demagnetizing field, and each value of them is absolute value),

if a total flux is defined as F_2 under the application of an effective magnetic field of 400 kA/m, and

if a total flux is defined as F_3 under the application of an effective magnetic field of 2,000 kA/m,

a magnetization rate $c (= F_1/F_3 \times 100)$ is 60% or more, and

a magnetization rate $d (= F_2/F_3 \times 100)$ is 85% or more.

13. (Original) An R-T-B system rare earth permanent magnet according to claim 12, which has a coercive force (H_{cJ}) of more than 1,680 kA/m.

14. (Original) An R-T-B system rare earth permanent magnet according to claim 12, which has a residual flux density (B_r) of 1.20 T or more, a maximum energy product ($(BH)_{max}$) of 240 kJ/m³ or more, and a squareness (H_k/H_{cJ}) of 90% or more.

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15. (Original) An R-T-B system rare earth permanent magnet according to claim 12, wherein a mean grain size is between 3.5 and 5.0 μm in said sintered body.

16. (Original) An R-T-B system rare earth permanent magnet according to claim 12, wherein the amount of oxygen is 1,500 ppm or less in said sintered body.

17. (Original) An R-T-B system rare earth permanent magnet according to claim 12, wherein Nb is dispersed in said sintered body.

18. (Canceled)

19. (Previously presented) An R-T-B system rare earth permanent magnet according to claim 33, which comprises 4.0% to 12.0% by weight of Dy and/or 1.0% to 6.0% by weight of Tb as R.

20. (Previously presented) An R-T-B system rare earth permanent magnet according to claim 33, wherein Zr is dispersed in the grain boundary phase of said sintered body.

21. (Previously presented) An R-T-B system rare earth permanent magnet according to claim 33, which is a multipolar magnet.

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22. (Previously presented) An R-T-B system rare earth permanent magnet according to claim 33, wherein the amount of nitrogen is 20 to 600 ppm and the amount of carbon is 1,500 ppm or less in said sintered body.

23. (Previously presented) An R-T-B system rare earth permanent magnet according to claim 33, which comprises 0.02% to 1.5% by weight of Ga.

24. (Original) A multipolar magnet having multiple N and S polarities, which comprises a sintered body with a composition comprising of 25% to 35% by weight of R (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y)), 0.5% to 4.5% by weight of B, 0.02% to 0.5% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 2% or less (excluding 0) by weight of Co, and the balance substantially being Fe,

wherein 0.1% to 4.0% by weight of Dy is comprised as said R, and

when P_c (permeance coefficient) is 2,

if a total flux is defined as f_1 under the application of an effective magnetic field of 240 kA/m (providing that an effective magnetic field = an applied magnetic field - a demagnetizing field, and each value of them is absolute value),

if a total flux is defined as f_2 under the application of an effective magnetic field of 800 kA/m, and

if a total flux is defined as f_3 under the application of an effective magnetic field of 2,000 kA/m,

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a magnetization rate $a (= f1/f3 \times 100)$ is 40% or more, and
a magnetization rate $b (= f2/f3 \times 100)$ is 90% or more.

25. (Original) A multipolar magnet having multiple N and S polarities, which comprises a sintered body with a composition comprising of 25% to 35% by weight of R (wherein R represents one or more rare earth elements), 0.5% to 4.5% by weight of B, 0.02% to 0.5% by weight of Al and/or Cu, 0.2% to 1.5% by weight of Nb and/or 0.03% to 0.25% by weight of Zr, 2% or less (excluding 0) by weight of Co, and the balance substantially being Fe,

wherein 4.0% to 12.0% by weight of Dy and/or 1.0% to 6.0% by weight of Tb are comprised as said R, and

when P_c (permeance coefficient) is 2,

if a total flux is defined as $F1$ under the application of an effective magnetic field of 240 kA/m (providing that an effective magnetic field = an applied magnetic field - a demagnetizing field, and each value of them is absolute value),

if a total flux is defined as $F2$ under the application of an effective magnetic field of 400 kA/m, and

if a total flux is defined as $F3$ under the application of an effective magnetic field of 2,000 kA/m,

a magnetization rate $c (= F1/F3 \times 100)$ is 60% or more, and

a magnetization rate $d (= F2/F3 \times 100)$ is 85% or more.

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26. (Currently amended) An R-T-B system rare earth permanent magnet, which comprises a sintered body with a composition consisting essentially of 25% to 35% by weight of R (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y)), 0.5% to 4.5% by weight of B, 0.02% to 0.5% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 2% or less (excluding O) by weight of Co, and the balance substantially being Fe,

wherein the amount of oxygen is 2,000 ppm or less in said sintered body, and a mean grain size is between 3.3 and 4.3 μm in said sintered body

wherein the amount of nitrogen is 20 to 600 ppm and the amount of carbon is 1,500 ppm or less in said sintered body.

27. (Currently amended) An R-T-B system rare earth permanent magnet, which comprises a sintered body with a composition consisting essentially of 25% to 35% by weight of R (wherein R represents one or more rare earth elements), 0.5% to 4.5% by weight of B, 0.02% to 0.5% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 2% or less (excluding O) by weight of Co, and the balance substantially being Fe,

wherein the amount of oxygen is 2,000 ppm or less in said sintered body, and a mean grain size is between 3.5 and 5.0 μm in said sintered body

wherein the amount of nitrogen is 20 to 600 ppm and the amount of carbon is 1,500 ppm or less in said sintered body.

28. (Original) A multipolar magnet having multiple N and S polarities, which comprises a sintered body with a composition consisting essentially of 25% to

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35% by weight of R (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y)), 0.5% to 4.5% by weight of B, 0.02% to 0.5% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 2% or less (excluding O) by weight of Co, and the balance substantially being Fe,

wherein 0.1% to 4.0% by weight of Dy is contained as said R, and

when μ_c (permeance coefficient) is 2,

if a total flux is defined as ϕ_1 under the application of an effective magnetic field of 240 kA/m (providing that an effective magnetic field = an applied magnetic field - a demagnetizing field, and each value of them is absolute value),

if a total flux is defined as ϕ_2 under the application of an effective magnetic field of 800 kA/m, and

if a total flux is defined as ϕ_3 under the application of an effective magnetic field of 2,000 kA/m,

a magnetization rate $a (= \phi_1/\phi_3 \times 100)$ is 40% or more, and

a magnetization rate $b (= \phi_2/\phi_3 \times 100)$ is 90% or more.

29. (Original) A multipolar magnet having multiple N and S polarities, which comprises a sintered body with a composition consisting essentially of 25% to 35% by weight of R (wherein R represents one or more rare earth elements), 0.5% to 4.5% by weight of B, 0.02% to 0.5% by weight of Al and/or Cu, 0.2% to 1.5% by weight of Nb and/or 0.03% to 0.25% by weight of Zr, 2% or less (excluding O) by weight of Co, and the balance substantially being Fe,

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wherein 4.0% to 12.0% by weight of Dy and/or 1.0% to 6.0% by weight of Tb are contained as said R, and

when Pc (permeance coefficient) is 2,

if a total flux is defined as F1 under the application of an effective magnetic field of 240 kA/m (providing that an effective magnetic field = an applied magnetic field - a demagnetizing field, and each value of them is absolute value),

if a total flux is defined as F2 under the application of an effective magnetic field of 400 kA/m, and

if a total flux is defined as F3 under the application of an effective magnetic field of 2,000 kA/m,

a magnetization rate c ($= F1/F3 \times 100$) is 60% or more, and

a magnetization rate d ($= F2/F3 \times 100$) is 85% or more.

30. (Previously presented) An R-T-B system rare earth permanent magnet according to claim 33, which comprises 0.2% to 1.5% by weight of Nb.

31. (Previously Presented) An R-T-B system rare earth permanent magnet according to claim 30, wherein Nb is dispersed in the main phase and the grain boundary phase of said sintered body.

32. (Previously Presented) An R-T-B system rare earth permanent magnet, which comprises a sintered body with a composition comprising of 25% to 35% by weight of R (wherein R represents one or more rare earth elements), 0.5% to

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4.5% by weight of B, 0.02% to 0.5% by weight of Al and/or Cu, 0.2% to 1.5% by weight of Nb, 2% or less (excluding 0) by weight of Co, and the balance substantially being Fe,

wherein the amount of oxygen is 2,000 ppm or less in said sintered body, a mean grain size is between 3.5 and 5.0 μm in said sintered body, Nb is dispersed in the main phase and the grain boundary phase of said sintered body.

33. (Previously Presented) An R-T-B system rare earth permanent magnet, which comprises a sintered body comprising:

an $\text{R}_2\text{T}_{14}\text{B}$ phase (wherein R represents one or more rare earth elements (providing that the rare earth elements include Y) and T represents one or more transition metal elements essentially comprising Fe, or Fe and Co) as a main phase; and

a grain boundary phase containing a higher amount of R than said main phase, wherein:

said sintered body has a composition comprising of 25% to 35% by weight of R, 0.5% to 4.5% by weight of B, 0.02% to 0.5% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 2% or less (excluding 0) by weight of Co, and the balance substantially being Fe,

the amount of oxygen is 2,000 ppm or less in said sintered body, and a mean grain size is between 3.5 and 5.0 μm in said sintered body and

when Pc (permeance coefficient) is 2,

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if a total flux is defined as F1 under the application of an effective magnetic field of 240 kA/m (providing that an effective magnetic field = an applied magnetic field - a demagnetizing field, and each value of them is absolute value),

if a total flux is defined as F2 under the application of an effective magnetic field of 400 kA/m, and

if a total flux is defined as F3 under the application of an effective magnetic field of 2,000 kA/m,

a magnetization rate c ($= F1/F3 \times 100$) is 60% or more, and

a magnetization rate d ($= F2/F3 \times 100$) is 85% or more.

34. (Previously Presented) An R-T-B system rare earth permanent magnet, which comprises a sintered body with a composition comprising of 25% to 35% by weight of R (wherein R represents one or more rare earth elements), 0.5% to 4.5% by weight of B, 0.02% to 0.5% by weight of Al and/or Cu, 0.03% to 0.25% by weight of Zr, 2% or less (excluding O) by weight of Co, and the balance substantially being Fe,

wherein the amount of oxygen is 2,000 ppm or less in said sintered body, and a mean grain size is between 3.5 and 5.0 μm in said sintered body,

wherein Zr is dispersed in the grain boundary phase of said sintered body.